Lessons from the Financial Crisis:
Bank Performance and Regulatory Reform

by Neville Arjani and Graydon Paulin

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Acknowledgements

Abstract

The financial systems of some countries fared materially better than others during the global financial crisis of 2007–09. The performance of the Canadian banking system during this period was relatively strong. Using a case study approach together with empirical analysis, we assess some of the factors that contributed to this favourable outcome with a view to drawing useful lessons for regulatory reform. We argue that an important contributor to positive bank performance was a solid approach to risk management on the part of the Canadian banking system, an approach that was actively fostered by the domestic authorities. Efforts to buttress risk management were favourably influenced by several stressful yet instructive episodes in Canadian financial history. The 2007–09 crisis experience suggests a need to make risk management a pervasive element of financial system culture and emphasizes the importance of robust liquidity management.

JEL classification: G21, G28
Bank classification: Financial institutions; Financial system regulation and policy

Résumé

Les systèmes financiers de certains pays se sont bien mieux comportés que d'autres lors de la crise financière mondiale de 2007-2009. Le système bancaire canadien ayant fait relativement bonne figure durant cette période, les auteurs ont recours à une méthode des cas qu'ils combinent à des analyses empiriques pour évaluer certains des facteurs ayant favorisé ce résultat, dans le but de tirer des leçons utiles à une réforme de la réglementation. Ils font valoir qu'un des éléments ayant contribué de façon importante à la bonne tenue des institutions financières a été la solide approche en matière de gestion du risque adoptée par le système bancaire canadien, une approche que les autorités du pays ont activement soutenue. Les bilans tirés de plusieurs périodes de tensions qui ont marqué l'histoire financière canadienne ont eu une incidence bénéfique sur les efforts déployés pour améliorer la gestion du risque au pays. Les enseignements de la crise de 2007-2009 donnent à penser que la gestion du risque devrait être au cœur de la culture du système financier et font ressortir l'importance d'une gestion rigoureuse de la liquidité.

Classification JEL : G21, G28
Classification de la Banque : Institutions financières; Réglementation et politiques relatives au système financier

1. Introduction

The 2007–09 global financial turmoil affected banking systems around the world, including Canada's. Nevertheless, Canadian banks are regarded as having performed relatively well. They did not, for example, require capital injections at any time, nor did deposit guarantees have to be expanded. Using both a case study approach and empirical analysis, we use this experience to identify some of the factors that contributed positively to bank performance, and in turn draw some useful lessons for global regulatory reform going forward. In particular, we argue that one important contributing factor was a solid approach to risk management on the part of the Canadian banks, an approach that was actively fostered by the domestic authorities. This does not preclude other elements having played an important role in the performance of Canadian banks, but we do not pursue them here.[1]

A variety of factors contributed to the evolution of institutional risk management in Canada. One of these was past difficulties in the Canadian financial system. Although Canada has never experienced a banking sector crisis as defined by several prominent studies, historically there were still some important negative shocks.[2] These include the failure of two smaller banks in the 1980s (the first failures since 1923), and substantial problems in the housing sector in the early 1980s and again in the early 1990s. The problems in the housing sector in the 1980s proved especially challenging for Canada's trust and loan company sector. A number of trusts were subsequently acquired by the major banks. Canadian authorities' reaction to these and other developments encouraged an environment of prudent risk-taking and improved crisis response.

The Canadian financial system did not, however, emerge from the recent financial crisis unscathed. For example, the non-bank asset-backed commercial paper (ABCP) market proved to have an unstable business model and effectively closed down. Canadian financial markets and institutions were also affected by liquidity and funding pressures, which led to supportive liquidity actions on the part of the central bank and federal government. Nevertheless, the period of increased global uncertainty that re-emerged in 2011, focused this time in Europe, was again characterized by a strong relative performance on the part of Canadian banks.

The structure of this paper is as follows. In section 2 we review the performance of the Canadian banking system during the financial crisis, and highlight relevant structural aspects that likely influenced this outcome. Based on financial statement data from an international sample of 78 large banks, section 3 presents analysis that draws on a range of statistical evidence to identify discernible patterns between banks' pre-crisis characteristics and their

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[1] See, for example, Bordo, Redish and Rockoff (2011); Cecchetti, King and Yetman (2011); Knight (2011).

[2] Reinhart and Rogoff (2009) and Laeven and Valencia (2008) find that Canada is one of only two G-20 countries that has not had a financial crisis over an extended period.

crisis performance. We discuss the results of this analysis with specific reference to the major Canadian banks. Section 4 discusses several key historical episodes of domestic financial stress, and in turn the domestic regulatory environment that they helped motivate. We review how this regulatory environment, among other elements, contributed to increased stability among Canadian banks.

Taken together, this evidence suggests some areas to emphasize as part of ongoing efforts in Canada and abroad to buttress financial systems. This includes an expanded emphasis on bank risk management, which needs to be pervasive in scope, including attention to robust liquidity management. These lessons are summarized in the final section.

2. Relative Performance of the Domestic Banking System

We present some stylized facts on the relative experience of the Canadian banking system since 2007, and summarize several structural factors that likely influenced outcomes.

2.1 Financial system performance

As the global financial system entered the recent financial crisis, Canadian banks, in a painful lesson on the potency of cross-border contagion in financial markets, experienced significant liquidity pressures as funding costs tightened. Nevertheless, funding costs did not rise by nearly as much for Canadian banks as elsewhere, and they were generally viewed by markets throughout the period of turmoil as being among the top tier of borrowers (Chart 1). They also benefited from strong inflows of retail deposits, a reflection of the confidence that they engendered.[3] Bank valuations fell, as in other countries, but subsequently exhibited a strong recovery (Chart 2).

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[3] The positive contribution that a strong retail funding base can provide is discussed in Ratnovski and Huang (2009).

Chart 1: Short-term funding markets
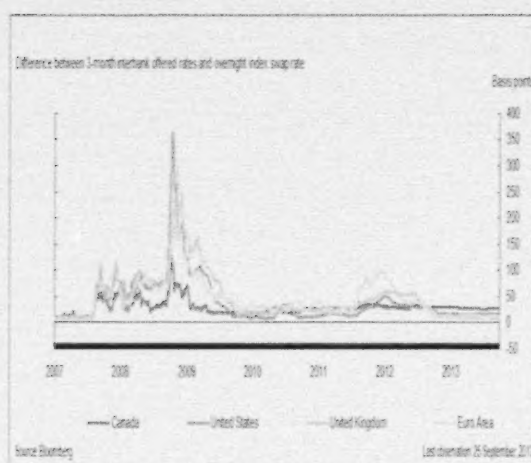
Chart 2: Bank valuations
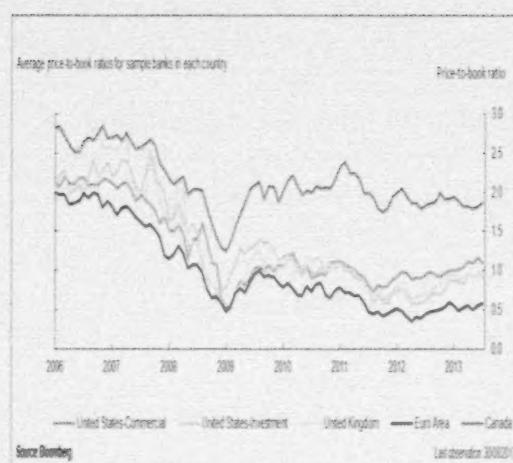
Funding pressures were, however, sufficiently serious to warrant an official response. The Bank of Canada provided short-term liquidity support (generally 1-month to 1-year terms) to the financial system through several programs that expanded upon its traditional liquidity tools. Terms to maturity, amounts, counterparties and the range of eligible securities were all adjusted to meet the extraordinary requirements of that period. By early 2010, these exceptional liquidity programs had ceased to provide new funds, and the amount of extraordinary liquidity provision on the central bank's balance sheet rapidly fell to zero.[4]

The Canadian government also provided longer-term funding support (up to five years) to Canadian banks. In particular, the Insured Mortgage Purchase Program (IMPP) allowed the commercial banks to sell their insured residential mortgages to the federal government-owned Canada Mortgage and Housing Corporation (CMHC). This successful program, representing a source of funds for banks at favourable terms, was expanded several times until a potential Can$125 billion was available; however, only about Can$70 billion was ultimately used.

The relatively strong performance of Canadian banks was, however, also reflected in a variety of other dimensions. While credit losses rose in line with the global recession and the accompanying rise in household and business defaults, the Canadian banking system performed well in relation to U.S. and other foreign banks, and compared with their own past experience. Charge-off rates on loans, for example, remained at modest levels (Chart 3). Losses were concentrated in banks' business sector exposures (as opposed to household exposures), but even here, losses were low compared with earlier historical episodes, aided by the strong balance sheet of the aggregate Canadian business sector at the beginning of the crisis.

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[4] In May 2010, in response to the re-emergence of U.S.-dollar funding pressures in Europe, the Bank of Canada, along with other central banks, reintroduced temporary U.S.-dollar liquidity swap facilities. For more discussion on the Bank of Canada's liquidity actions during the crisis, see Zorn, Wilkins and Engert (2009).

Cumulative writedowns, which are more reflective of losses on the banks' trading books, were also comparatively low. These low loss rates helped to contain the need to build provisions and supported the banks' profitability. The average return on equity of the Canadian banking system fell during the crisis, but remained substantially positive throughout (Chart 4). Not only did this compare favourably with the experiences in the banking sectors of other countries, but it also compared well with previous episodes of stress in the Canadian banking system (e.g., in the early 1990s).
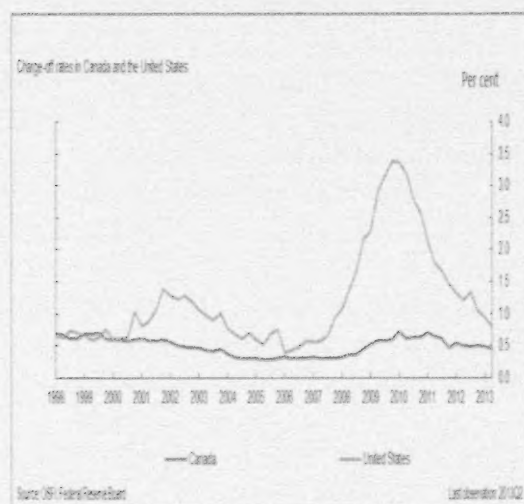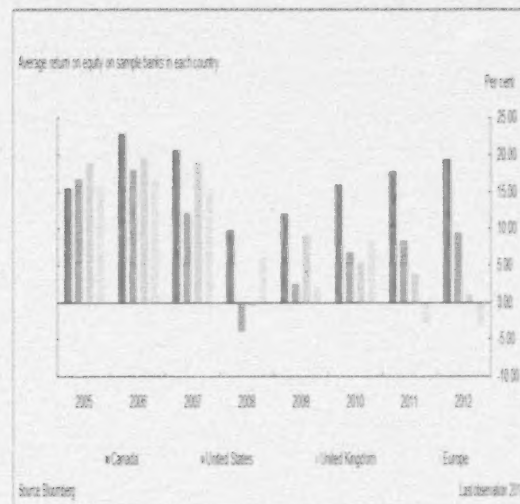
Chart 3: Credit charge-off rates   **Chart 4: Return on equity**

The more recent period of global financial turmoil in 2011–12, with its greater emphasis on problems emerging from the euro area, has confirmed the relatively strong performance of Canadian banks. The major banks have retained their preferred borrower status, with their funding costs adjusting only marginally higher during the ongoing period of increased stress, and market valuations have remained robust (recall Charts 1 and 2).

2.2 Financial system structure

The structure of the Canadian financial system likely influenced Canadian banks' strong performance during the crisis. The Canadian banking system is dominated by five or six large banks that together hold the majority of domestic banking assets. Independent investment banks are not present; the once-independent large Canadian investment dealers were absorbed by the major banks following legislative changes in the early 1980s. Major Canadian banks' investment banking activity – as part of the larger bank – falls under the prudential oversight of a single regulator, the Office of the Superintendent of Financial Institutions (OSFI). Moreover, the large Canadian banks are diversified geographically and across product lines.
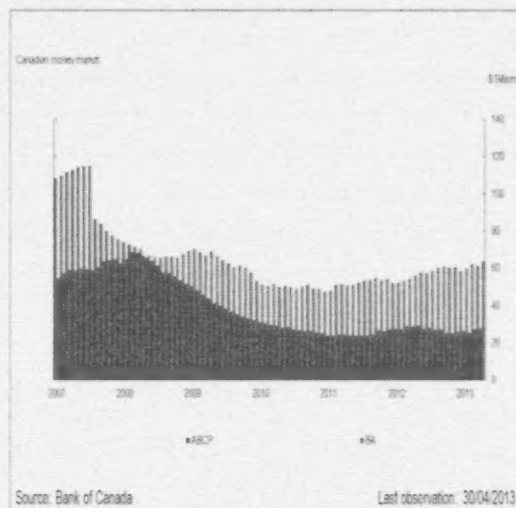
Another potentially important element is the interaction between the traditional banking sector and the shadow banking system. Shadow banking is not unimportant in Canada, but rather than being roughly equal to or larger than traditional banking, as in the United States, it is substantially smaller in Canada (Chart 5). The composition is also very different. The repo market, heavily based on Canadian government paper, is an important component. However, the securitization of mortgages has increased sharply largely owing to the issuance of government-backed National Housing Act Mortgage-Backed Securities (NHA MBS) (see Gravelle, Grieder and Lavoie 2013). In the United States, activity from government-sponsored enterprises, asset-backed securities and money-market funds are all relatively important. Reflecting these differences in composition, there is a greater relative participation by regulated Canadian financial institutions in the shadow banking sector.

The shadow banking sector in Canada incorporates a wide range of activities. Some of them are relatively risky, such as the ABCP market. As noted earlier, the non-bank ABCP market collapsed in Canada at the onset of the financial crisis, although it was relatively small (Chart 6). The bank-sponsored ABCP market, with its superior liquidity characteristics, did not experience similar problems. Canadian bank exposures to less-risky activities were much larger, including the government-backed NHA MBS sector. Overall, shadow banking likely represented less of a risk to the Canadian financial system and domestic banks than it did for similar U.S. entities.

Chart 5: Shadow banking sector

Sources: Bank of Canada, Canada Housing and Mortgage Corporation, Investment Fund Institute of Canada, DBRS and Bank of Canada calculations

Last observation: 2013Q1

Chart 6: Canadian ABCP market

Source: Bank of Canada

Last observation: 30/04/2013

A key part of the environment in which Canadian banks operate is the domestic housing finance system, which exhibited considerable resilience during the 2007–09 crisis. An important feature is that mortgages provided by federally regulated lending institutions must be insured against default when the loan-to-value ratio exceeds 80 per cent. The majority of mortgage insurance is

provided by CMHC, which operates on a commercial basis.[5] However, as a government-owned corporation, CMHC is fully backed by the Canadian government.[6]

CMHC has two significant securitization programs. The first, the NHA MBS, comprises securities backed by pools of residential mortgages insured by CMHC or private mortgage insurers, with the former carrying a full guarantee from CMHC and thus the Government of Canada. The complementary Canada Mortgage Bond (CMB) program was created more recently in 2001. CMBs are issued by the Canada Housing Trust, with the proceeds used to purchase NHA MBS. They are similarly backed by the CMHC/Canadian government.

Insured mortgages represent approximately three-quarters of total residential mortgages, of which two-thirds is insured by CMHC. The CMB and NHA MBS programs together comprise about one-third of total residential mortgage financing in Canada. As mentioned, during the financial crisis, CMHC administered the IMPP, which allowed the Canadian banks to sell their NHA MBS to the government within authorized limits as a means of funding support.

Prudent risk-taking by lenders in the housing sector, supported by a robust financing model, contributed to quite different outcomes compared to the United States.[7] Housing prices in Canada experienced a relatively mild deceleration, due to a number of underlying factors (Chart 7). A particularly striking development was the amount of household equity held in real estate assets, which remained at historical levels as opposed to falling dramatically, as in the United States (Chart 8). Mortgage defaults also remained at comparatively low levels and, as the economy moved into recovery, the housing sector picked up quickly (Chart 9).

This dynamic benefited from a feedback mechanism, whereby a solid Canadian banking system supported ongoing intermediation which, in turn, helped to strengthen the financial position of Canadian banks.[8] For these banks, the growth of household credit, including residential mortgage credit, remained relatively robust during the downturn, and close to historical averages. House prices, after a brief downturn, regained their upward momentum, and household indebtedness increased in contrast to the deleveraging evident in the U.S. and many other economies. Concerns over these trends, however, and the potential exposure of Canadian banks (and other financial institutions) to these developments, led the authorities to

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[5] CMHC was established in 1954. Two smaller private insurers are also active in the domestic market: Genworth and Canada Guaranty. Their mortgage insurance programs are also backed by the government, but to a maximum of 90 per cent.

[6] See Kiff, Mennill and Paulin (2010, 53–56), for additional detail on the role of CMHC and structure of mortgage finance, and its contribution to financial stability.

[7] As Northcott, Paulin and White (2009) note, prior to the crisis most mortgages were originated by the Canadian banks for their own balance sheets which, in turn, generated an incentive to maintain high underwriting standards. Moreover, in Canada, securitization of mortgages is primarily for liquidity generation rather than risk transfer.

[8] Although Canadian banks did move to augment their capital from private markets during the financial turmoil, they were not under the same pressure to deleverage as occurred elsewhere.

introduce a range of measures to help ensure that mortgage lending is soundly based.[9] The total credit-to-GDP gap in Canada, and the household credit-to-GDP gap, have narrowed considerably since 2009 (Chart 10).[10]

Chart 7: House prices (2000Q1=100)
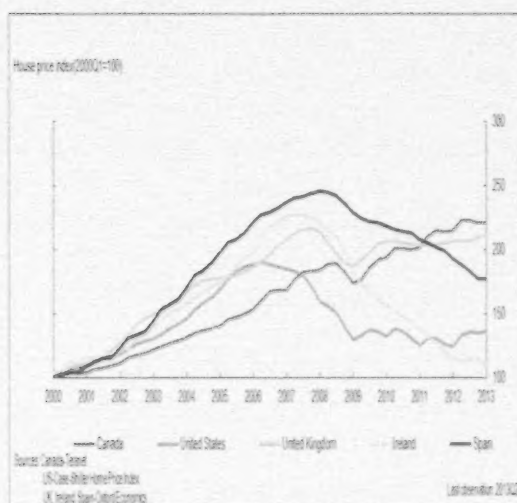
Chart 8: Real estate equity
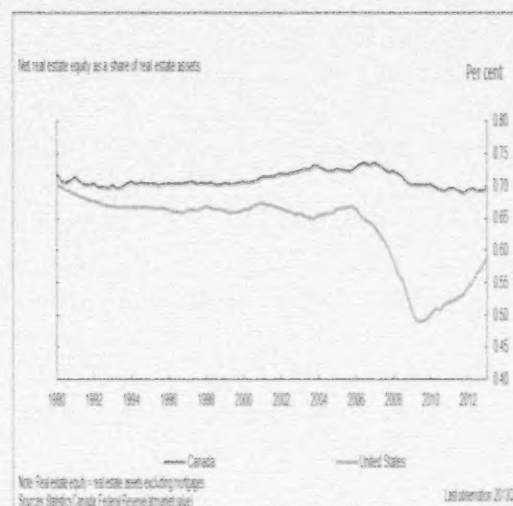
Chart 9: Mortgage delinquencies
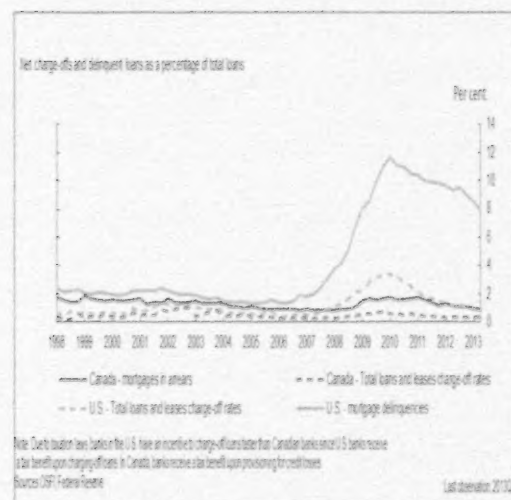
Chart 10: Credit-to-GDP gap

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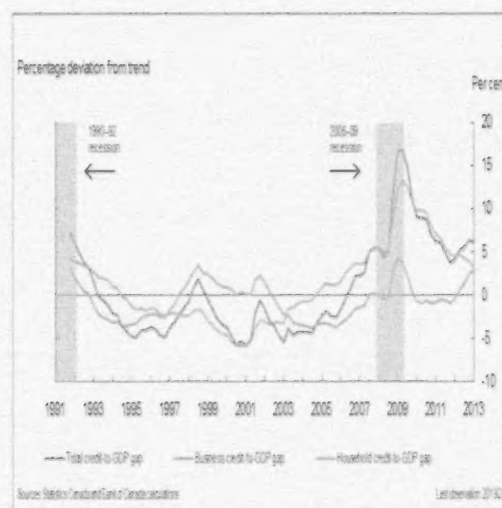
[9] Beginning in 2008, the government took a number of steps to strengthen mortgage lending standards. Most recently, in June 2012, the maximum amortization was reduced to 25 years from 30 years, and maximum refinancing amounts were reduced (among other measures). Also in June, OSFI released updated guidelines on residential mortgage underwriting, consistent with new principles from the Financial Stability Board. The Bank of Canada regularly publishes its views on risks with respect to Canadian household finances and the housing market, most recently in the June 2013 *Financial System Review* (pp. 19–25).

[10] For a discussion of the credit-to-GDP gap, see Box 3 (p. 22) in the June 2011 issue of the *Financial System Review*.

With the above as background, we turn to an empirical analysis of the factors that may have contributed to stronger outcomes among certain banks, using cross-country balance-sheet and income statement data.

3. Factors Underpinning Bank Performance – International Evidence

During the financial crisis of 2007–09, losses in the global banking sector totalled over US$1.5 trillion.[11] During this period, however, individual bank performance exhibited high variance, even among banks headquartered in the same country. The natural question is: *why did some global banks perform better than others during this period?*

Some commonly cited preconditions for poor bank performance during the crisis include:

- Heavy reliance on short-term funding, coupled with a large share of asset portfolios comprising securities that proved to be illiquid and of poor credit quality.
- A shift away from traditional business lines toward more volatile sources of revenue, such as capital markets activity, including the structure and sale of complex credit products.
- An inadequate understanding among bank management about risks being taken, and over-confidence in the quality of hedges in place. More generally, a lack of appropriate investment in, and adherence to, the bank's risk-management function.
- Related to the above, a lack of sufficient bank capital commensurate with risks being taken.
- A compensation structure that led to misaligned incentives throughout the organization.
- A lack of effective governance on the part of bank boards and shareholders. At the same time, the expectation of too-big-to-fail in many countries led to the decline of market discipline among large banks' fixed-income investors and depositors, which could also motivate the preceding adverse conditions.
- A lack of effective prudential regulation and supervision, and insufficient risk capture in international standards for the regulation of bank capital.

Several studies have investigated these hypotheses; for example, Ellul and Yerramilli (2013), Demirgüç-Kunt, Detragiache and Merrouche (2010), IMF (2009), Beltratti and Stulz (2009), and Ratnovski and Huang (2009). The latter researchers focus specifically on the resilience of the major Canadian banks during the crisis.

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[11] This figure is based on Bloomberg's writedown and capital injection data. Writedowns by the six major Canadian banks amounted to over US$47 billion during 2007–09. Worldwide writedowns by all financial institutions tracked by this Bloomberg function (including global banks, insurers and government-sponsored enterprises in the United States) were in excess of US$2 trillion during the same period. The Bloomberg data were accessed on 30 July 2012.

Our analysis complements and extends these earlier studies. We find evidence to suggest that global banks' pre-crisis business model, funding model and balance-sheet liquidity were key determinants of crisis performance. While specific measurement of the quality of banks' risk-management practices is challenging, these findings suggest that banks exhibiting relatively prudent pre-crisis risk-management practices performed better during the crisis.[12] Somewhat surprisingly, our empirical analysis also suggests that banks' pre-crisis regulatory capital levels and overall leverage levels were not significant determinants of crisis performance. As will be discussed, however, our measure of leverage is imperfect, since it does not capture the extent of banks' off-balance-sheet activity preceding the crisis, so our results pertaining to this factor should be interpreted with caution.

Our analysis concludes by focusing on the major Canadian banks in the context of the results above. We find that Canadian banks stood out among their global peers in terms of their pre-crisis funding model and balance-sheet liquidity, as measured by this study. We also find evidence that Canadian banks' continued focus on more traditional lines of business in the lead-up to the crisis served as an additional source of strength to help weather the intense financial market malaise during 2007–09.

Note that our analysis is not intended to produce an exhaustive list of factors contributing to global banks' performance during the crisis. Rather, it is intended to highlight some common characteristics identified in the pre-crisis balance sheet and income statement of banks that fared well during the crisis and those that did not. We recognize that banks' performance during the crisis could also have been influenced by other firm-specific characteristics not explicitly captured in our analysis, as well as by different structural, legal and regulatory characteristics applying to each jurisdiction that may not be reflected in our measured variables.

3.1 Empirical analysis

3.1.1 Sample selection

Our sample consists of 78 global banks from 20 countries, and is constrained to banks reporting balance-sheet assets of at least US$100 billion at fiscal year-end 2006. The aggregate balance-sheet size of our sample was US$51 trillion at the end of 2006, while average size per bank was just over US$650 million (median size was US$470 million). Sample selection was largely guided

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[12] This view is supported by Ellul and Yerramilli (2013), who find evidence that, among the largest bank holding companies in the United States, institutions with strong and independent risk-management functions had lower risk exposures in the years leading up to the financial crisis, and fared relatively better during the crisis years. A key contribution by these researchers is the development of a risk-management index, which is intended to measure the importance attached to the risk-management function within each institution, and the quality of risk oversight provided by the institution's board of directors.

by data availability. Of note, our sample includes the six major Canadian banks, as well as the five major U.S. investment houses, some of which were subsequently converted into bank holding companies during the crisis.[13] All data used in the analysis were collected at the consolidated (group) level, in accordance with the accounting scope of consolidation.

3.1.2 Assessing crisis performance

We rely on a binary indicator of bank performance during the crisis. The indicator takes the value of 1 if a bank was "bailed out" during the crisis, and a value of 0 if a bank was "not bailed out." To be bailed out, one or more of the following three events had to occur during 2008–09:[14]

1) The bank was declared bankrupt.
2) The bank was acquired either by another private bank (perhaps via a government-assisted transaction) or by their home government via nationalization.
3) The bank received capital support from either a national or a state government.

Some additional points of clarification are in order regarding our performance metric. First, where, for example, a bank benefited from extraordinary liquidity assistance from a central bank, or from a public guarantee on its debt or the debt of a subsidiary, this does not qualify as a bailout in our study. Nonetheless, it is understood that these measures certainly could have prevented the bank from becoming distressed even where it did not receive public capital support. Second, some global banks have claimed publicly that they were "forced" to take capital assistance during the crisis, despite not needing it. It is challenging, however, to assess such claims, even ex post, and thus all banks in our sample that received public capital support during 2008–09 are classified as being "bailed out," regardless of the conditions under which the support was offered.

Table 1 reports summary statistics on our chosen metric of crisis performance. By coincidence, the sample is evenly divided between banks that required a bailout and those that did not. To further assess the validity of our binary variable as an indicator of bank performance, where data are available, we cross-check our indicator against some alternative measures of crisis performance, including: (i) change in the ratio of market-to-book value of equity between end-2006 and end-2008; (ii) average annual return-on-assets (ROA) during 2007–09; and, (iii)

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[13] Appendix A provides a complete list of the banks comprising our sample.

[14] Data used to construct this binary variable include those provided by Bloomberg's writedown and capital injection function, as well as those provided by a comprehensive bailout database compiled by Grail Research. The Grail Research database used for this analysis is dated 12 September 2009, and is available online at http://grailresearch.com/pdf/ContenPodsPdf/Global_Bailout_Tracker.pdf. Media reports and banks' own annual reports were used to reconcile any discrepancies between these two main sources.

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average annual net charge-offs as a proportion of total loans outstanding during 2007–09. For the latter two measures, group median values are provided in parentheses in Table 1.[15]

Table 1: Summary of sample banks' crisis performance according to bailout indicator

	Bailed-out banks	Non-bailed-out banks
Number of banks	39	39
	Of which: *Bankrupt: 2* *Acquired privately: 5* *Nationalized: 2* *Capital support: 30*	
Change in ratio of market-to-book equity (Data available for 69 out of 78 banks)	Ratio at end-2006: **2.07** Ratio at end-2008: **0.71** Percentage change: **-66.4**	Ratio at end-2006: **2.52 ***** Ratio at end-2008: **1.22 ***** Percentage change: **-52.6 ****
Average annual pre-tax ROA (2007–09) (Data available for 72 out of 78 banks)	0.1% (0.1%)	0.8% *** (0.7%)
Average annual net charge-off to total loans outstanding (2007–09) (Data available for 58 out of 78 banks)	0.9% (0.8%)	0.4% *** (0.3%)

Notes: The market-to-book equity ratio at end-2008 for the bankrupt banks in our sample is recorded as zero, representing a percentage change of 100 per cent. For acquired/nationalized banks, the end-2008 ratio represents data reported by the bank in the fiscal quarter immediately before being acquired. Ratio and percentage change figures are based on the mean of the sample group in question. For the ROA and net charge-off indicators, mean and median values are reported in the second and third columns for the banks in each category (medians in parentheses). Mean and median values for these indicators exclude banks that were declared bankrupt during the crisis period.
*** indicates a statistically significant result at the 1% level, based on a *t*-test of the difference in sample means (evidence that the two samples were chosen from separate underlying population distributions).
** indicates statistical significance at the 5% level.
Sources: Bloomberg, Grail Research, banks' annual reports

Our binary indicator is preferable to these other metrics largely on grounds of data availability. Nonetheless, the data reported in Table 1 suggest a close relationship between our indicator of crisis performance and the three alternative measures. That is, on average, bailed-out banks as defined in our study experienced a larger drop in market value during 2007–08, as well as poorer profitability and higher net loan charge-offs during 2007–09, compared to their non-

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[15] The 2006–08 time frame is chosen for our equity-based measure of crisis performance, compared to the 2007–09 period for our two accounting-based measures, given the leading-indicator properties of equity prices. Nine banks in our sample were not publicly traded during the period of study.

bailed-out peers. Of note, excluding the five major U.S. investment houses from the analysis in Table 1 results in a negligible change to the mean and median values reported, and no change to the results of our statistical tests.

3.1.3 Assessing pre-crisis bank conditions

Our choice of measures to reflect banks' pre-crisis condition is guided by the hypotheses put forward earlier; however, data limitations prevent testing of all these claims. Moreover, data availability could also temper the strength of a result even where a claim can be tested.[16] The analysis focuses on banks' pre-crisis (i) business model, (ii) funding model, (iii) balance-sheet leverage, (iv) risk appetite, (v) capital adequacy and quality, (vi) cost-efficiency, and (vii) balance-sheet liquidity. To capture conditions prior to the crisis, fiscal year-end 2006 data are used.[17] Measure variables are mostly presented in the form of ratios, facilitating a more meaningful comparison across banks given the high variance of bank size in our sample. Data used to build these variables were primarily collected from Bloomberg and Bankscope. Remaining data gaps were filled using banks' annual reports.

Individual variables reflecting pre-crisis conditions are constructed as follows.

- **Bank size**: This metric captures banks' balance-sheet size in US$ millions.

- **Business model**: Our hypothesis is that banks deviating from traditional lines of business in the lead-up to the crisis, in favour of more volatile revenue sources, fared relatively poorly when the crisis hit and liquidity dried up across numerous asset classes.

  We use the ratio of banks' trading account profit to total net revenue as our business model variable. The numerator is constructed by Bloomberg, and is intended to capture any gains (losses) derived from market-driven activities.

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[16] A key drawback of our analysis concerns data limitations. Given our aim to study and compare findings across a broad group of banks from a number of countries, it is important that data for each bank be in a comparable format, which means that characteristics unique to each bank, or to banks within a country or region, must be fitted into common data buckets. As a result, some useful bank- or country-specific insights could be compromised to complete the analysis. In addition, while granular regulatory and risk-management data would benefit our study (including more detailed data pertaining to banks' off-balance-sheet operations), these data are typically not readily (or publicly) accessible. As a result, publicly available accounting data are usually the researcher's only option. On the other hand, if one or more of the above hypotheses can be demonstrated empirically based on high-level consolidated accounting data, then that could be viewed as a positive outcome, and could suggest relatively strong supporting evidence of the claim in question.

[17] To test the sensitivity of our findings, where data were available, we expanded the pre-crisis period to the three years from 2004–06, taking the pre-crisis value for each indicator as the simple average of the three annual observations. Though unable to perform this analysis for all banks in the sample (due to unavailable data), results were generally consistent with those reported for 2006 alone.

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- *Funding model*: Our hypothesis is that banks relying more heavily on short-term and less-stable sources of funding performed relatively poorly during the crisis, as wholesale funding markets became significantly impaired amidst large global bank losses. The resulting asset fire sales drove prices even lower, causing banks to book large mark-to-market losses in their trading portfolios.

  We use the ratio of banks' short-term funding to total funding as our funding model variable, where the numerator is constructed by Bloomberg and includes, among other short-term sources of financing, banks' use of repurchase agreements. The numerator is essentially designed to capture all non-deposit funding liabilities expiring within one year. The denominator is manually compiled using Bloomberg data, and is calculated as the sum of total customer deposits, short-term funding and long-term funding.

  Some data limitations exist, however, in the construction of this variable. Specifically, further granularity in customer deposit data – for example, related to the maturity schedule of banks' fixed-term deposits, and also with respect to the breakdown between "retail" and "wholesale" deposit sources – is unavailable for some banks in the sample. As a result, potentially unstable and short-term deposit funding cannot be included in the numerator of the funding model measure, thereby prohibiting a more accurate depiction of banks' reliance on short-term and less-stable funding.

- *Regulatory capital adequacy and quality*: Our hypothesis is that banks entering the crisis with low and/or poorer-quality regulatory capital performed relatively worse during the crisis, as capital resources were insufficient to absorb the large credit and trading losses incurred during the crisis. In addition, outright loss absorption aside, it may also have been the case that a larger capital buffer over and above the regulatory target served as a positive signal to the market of a bank's ability to absorb losses were they to arise while continuing to meet contractual obligations, thus reducing investors' incentive to run.

  We use banks' Tier 1 regulatory capital ratio for our measure of the level of capital adequacy. Note that this indicator is not available for the major U.S. investment houses as of end-2006, since they were not required to report according to Basel standards at the time. As a result, these banks are excluded from the analysis pertaining to regulatory capital adequacy.

  Where data are available, we also calculate the ratio of core Tier 1 capital to total Tier 1 capital for our measure of banks' capital quality. Unfortunately, core Tier 1 capital does not

appear to have been widely reported by global banks prior to the crisis, and data are available for only 18 of 78 sample banks.

- **Leverage**: A hypothesis related to the preceding is that, more generally, banks operating with high leverage prior to the crisis performed relatively poorly during the crisis, since highly leveraged banks simply did not have sufficient equity to absorb the large trading and credit-related losses incurred during the crisis.

  We use the ratio of total balance-sheet assets to shareholder equity for our measure of leverage. Unlike the regulatory capital-based indicator above, this non-risk-adjusted leverage indicator is available for all banks in the sample.

  We recognize that a measure of leverage that captures banks' on- and off-balance-sheet exposure is highly desirable and would provide a better picture of pre-crisis vulnerabilities within our sample. However, lack of data regarding off-balance-sheet exposure for many banks in the sample precluded such a measure from being constructed for this analysis.

- **Risk appetite**: Our hypothesis is that banks exhibiting a greater appetite for risk prior to the crisis performed relatively worse during the crisis by, for example, taking positions in high-yield, largely illiquid, securities, or by extending loans to households and businesses with poor credit histories with the goal of ultimately selling such loans at a profit. That is, while increased risk-taking may have benefited a bank in the lead-up to the crisis during benign global economic and financial conditions, it came with a large price when the crisis hit and risky positions proved difficult, if not impossible, to unwind.

  Recognizing that risk appetite is difficult to measure, we use the ratio of banks' Basel risk-weighted assets (RWA) to total assets as a proxy for risk appetite. Given that our pre-crisis data are for end-2006, the numerator of this calculation reflects the Basel I capital standard for RWA determination. Recent research by Vallascas and Hagendorff (2012) suggests that RWA generally rises with banks' overall portfolio risk, so we view this variable as a potential proxy of banks' overall risk appetite leading up to the crisis.[18] Note that this indicator is also not available for the major U.S. investment houses as of end-2006, so these firms are excluded as well from analysis pertaining to this variable.

  We supplement the above proxy of risk appetite with an accounting-based measure of bank risk-taking – the Z-score – introduced by Roy (1952) and recently applied by Demirgüç-Kunt and Huizinga (2011) in a study of the relationship between bank size and risk. The Z-score is

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[18] However, these researchers raise concerns that RWA does not rise proportionately with increases in bank risk – that is, they conclude that the ratio of RWA to total assets is ill-calibrated to banks' asset volatility.

described as an accounting-based measure of distance to insolvency, where a higher value of the Z-score is indicative of greater bank safety. An accounting-based measure of bank risk is preferred since a number of banks in our sample are not publicly traded, ruling out use of other risk metrics that draw inference from equity prices. We calculate the numerator of the Z-score for each bank as the sum of the mean annual ROA and the mean leverage quotient, where mean values are calculated over the four years leading up to end-2006.[19] The leverage quotient is calculated as the ratio of shareholder equity to total assets. The denominator of the Z-score is calculated as the standard deviation of annual ROA measured over the same four-year period. As in Laevan and Levine (2009), we transform banks' Z-scores by taking their natural log values given the highly skewed nature of the original scores across our sample.

- **Cost-efficiency**: Our hypothesis is that banks with less cost-efficient operations fared relatively poorly during the crisis, since their pre-crisis margin was more vulnerable to the higher cost of borrowing during the crisis. A potential limitation of this hypothesis, however, could be that banks viewed as more cost-efficient prior to the crisis ultimately performed poorly during the crisis, reflecting their heavy pre-crisis reliance on low-cost short-term funding and a push toward more risky revenue sources, which, combined, would be expected to contribute to relatively strong cost-efficiency in 2006.

We use the ratio of banks' operating expenses to net revenue as our measure of cost-efficiency.

- **Balance-sheet liquidity**: Our hypothesis is that banks with a lower proportion of liquid assets fared worse during the crisis, particularly when a lack of asset-side liquidity was combined with a heavy reliance on short-term funding. As mentioned, when wholesale funding markets dried up, many banks were forced to liquidate assets, resulting in large writedowns in the case of less-liquid (hard-to-value) assets.

We measure balance-sheet liquidity as the ratio of banks' liquid assets to short-term funding – akin to a coverage ratio. The numerator is provided by Bankscope, and includes: (i) trading securities and other securities that are recorded at fair value, (ii) loans and advances to banks, (iii) reverse repurchase agreements and cash collateral, and (iv) cash and deposits due from banks. The numerator excludes mandatory reserve amounts. The denominator is provided by Bloomberg, and is the same short-term funding metric used in the numerator of our funding model measure.

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[19] If data are not available for a bank during the full four-year period leading up to 2006, a Z-score is not calculated.

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We recognize that this measure of liquid assets could be viewed as too liberal, given that many instruments held in the trading book, or which were carried at fair value, proved illiquid during the crisis. Moreover, this measure of balance-sheet liquidity may tend to put banks with large trading businesses in a favourable light, all else equal, thus influencing how balance-sheet liquidity is perceived as a determinant of crisis performance in this study. However, it is difficult to independently define and construct a more refined measure of liquid assets for banks in our sample, not least because of the wide spectrum of financial instruments and active jurisdictions represented.

To assess the hypotheses set out above, Table 2 provides mean statistics on the pre-crisis characteristics of the two sets of banks in our study (median values are provided in parentheses). Results of accompanying *t*-tests, which were carried out to assess the statistical significance of the observed differences in means, are also provided.

The mean statistics reported in Table 2 appear to support our hypotheses. On average, within our sample of 78 banks, institutions that performed poorly during the crisis entered the period with: (i) a relatively large proportion of annual net revenue generated from the trading business, (ii) a greater reliance on short-term, non-deposit sources of funding, (iii) a lower quantity and quality of regulatory capital, (iv) higher balance-sheet leverage, (v) a larger appetite for risk (based on our first proxy measure, in mean terms), (vi) lower cost-efficiency, and (vii) lower balance-sheet liquidity.[20]

For some indicators, however, the difference in means in Table 2 appears marginal and is not statistically significant. Based on our tests of statistical significance, the leading determinants of banks' crisis performance appear to be the pre-crisis business and funding models, as well as balance-sheet liquidity. For example, 20 of the 25 top-ranked banks according to our business model measure (i.e., the 25 banks with the highest proportion of net revenue derived from trading account profit) were bailed out during the crisis. Similarly, 22 of the 25 top-ranked banks according to our funding model measure (i.e., the 25 banks exhibiting the greatest reliance on short-term non-deposit sources of funding), and 16 of the 25 lowest-ranked banks according to our balance-sheet liquidity indicator (i.e., the 25 banks exhibiting the lowest liquid-asset coverage over their short-term funding), were bailed out during the crisis.

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[20] As expected, but not shown in Table 2, bailed-out banks in our sample reported a higher pre-tax ROA, on average, compared to their non-bailed-out peers at end-2006 (1.22 per cent versus 1.08 per cent).

Table 2: Comparing indicators across bank types (based on banks' fiscal year-end 2006 data)

Category	Data availability	Indicator description	Bailed-out banks	Non-bailed-out banks
Bank size	78 / 78	Total balance-sheet assets (US$ million)	705,800 (503,545)	615,739 (361,892)
Business model	78 / 78	Trading account profit / Net revenue	20.1 (16.6)	9.9 *** (9.4)
Funding model	78 / 78	Short-term funding / Total funding	35.1 (34.8)	20.7 *** (18.8)
Capital adequacy	73 / 78	Basel Tier 1 capital adequacy ratio	8.4 (8.2)	8.6 (8.4)
Capital quality	18 / 78	Core Tier 1 capital / Total Tier 1 capital	82.8 (82.9)	88.3 ** (88.1)
Risk appetite	73 / 78	Basel RWA / Total balance-sheet assets	54.0 (47.1)	51.9 (53.4)
Risk appetite (alternative)	70 / 78	Z-score (log value)	1.89 (1.79)	1.75 (1.76)
Leverage	78 / 78	Total assets / Shareholder equity	24.3 (26.2)	21.2 (19.3)
Cost-efficiency	78 / 78	Operating expenses / Net revenue	56.7 (59.0)	56.3 (55.6)
Balance-sheet liquidity	78 / 78	Liquid assets / Short-term funding	98.2 (82.3)	147.9 *** (129.7)

Notes: All figures are expressed as a percentage unless otherwise stated. Median values are reported in parentheses. *t*-test results: *** significant at 1% level; ** at 5% level; * at 10% level.

Table 2 shows that regulatory capital quality is also a statistically significant determinant of crisis performance in our sample; however, this result should be interpreted with caution given the very small sample size involved (i.e., data were available for only 18 banks). Within this group, four banks received a bailout, while none of the top-10 banks according to this measure (i.e., the 10 banks with the highest ratio of core capital to total Tier 1 capital) required a bailout during the crisis. Interestingly, the difference in the pre-crisis regulatory capital level between bailed-out and non-bailed-out banks is negligible, and this difference is not statistically

significant.[21] These results would appear to lend support to regulatory reform efforts aimed at improving the quality and reliability of this ratio as an indicator of bank soundness. To be clear, we do not interpret this finding as an argument that regulatory capital does not matter for bank soundness, but rather that improvements in the quality and reliability of the Basel capital ratio across jurisdictions appear warranted.

The differences in means for our risk appetite measures are also not significant. Moreover, our median statistics for risk appetite outright contradict our initial hypothesis, which we believe is likely to be more related to how risk appetite is being measured in our study, rather than being suggestive that pre-crisis risk appetite did not matter for crisis performance. Indeed, one might argue that our measures of business and funding model, as well as balance-sheet liquidity, implicitly reflect a bank's risk appetite to some extent.

Rounding out the results in Table 2, pre-crisis balance-sheet leverage and cost-efficiency do not appear to have played a significant role in global banks' crisis performance, though comparing median values across the two groups of banks provides somewhat stronger support for our initial hypothesis regarding the role of balance-sheet leverage.

Our general findings are consistent with our impressions about the key factors contributing to global banks' performance during the crisis – simply put, banks that engaged in a greater volume of fat-tailed revenue activity leading up to the crisis, and that relied more heavily on short-term non-deposit funding to support their growing exposure to largely illiquid securities portfolios, typically paid a high price (as did their shareholders) when the crisis hit and both asset and funding liquidity dried up.

As mentioned earlier, while measurement of the quality of banks' risk-management practices is elusive, our findings suggest that banks with relatively prudent risk-management practices in place prior to the crisis – encompassing choice of business model, funding model and balance-sheet liquidity – seem to have performed better during the crisis.

3.1.4 Robustness checks

We carry out three additional exercises to assess the robustness of our findings in Table 2. First, we observe that the underlying data for the two groups of banks (i.e., bailed out and not bailed out) across several of our indicator variables test positive for non-normality, and that they

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[21] Related findings have been reported by other researchers. For example, Demirgüç-Kunt, Detragiache and Merrouche (2010) find that, for large banks, neither risk-adjusted nor non-risk-adjusted capital levels of banks materially influenced banks' equity returns *prior to* the crisis. However, they do find that capital levels played a positive and significant role in influencing banks' equity returns *during* the crisis. Moreover, equity returns during the crisis appear to have been more sensitive to changes in banks' non-risk-adjusted capital level, which suggests that equity investors placed greater faith in these data as a measure of banks' ability to absorb loss as a going concern relative to the Basel-based risk-adjusted capital level.

contain outliers. Both of these factors could negatively affect the integrity of the two-sample test results. While *t*-procedures seem to work well for larger sample sizes even when data are clearly skewed, they can still be adversely affected by gross outliers. To test the possibility that our *t*-test results in Table 2 are misleading due to the presence of outliers, for the two groups of banks we eliminate all values below the 5th percentile and above the 95th percentile and repeat the mean-equality tests on each variable. Reassuringly, this produces no change to our main findings. As a further check, we perform non-parametric median-equality tests on our full sample and observe the same findings.

Second, we indicated earlier that our analysis is not intended to produce an exhaustive list of factors that contributed to banks' performance during the crisis. However, our data sample may be able to shed (limited) light on whether home-country characteristics might be influencing the results in Table 2.[22] Specifically, the data in Appendix A indicate that there are three countries (Germany, the United Kingdom and Switzerland) in the sample that produce at least one bank in both performance groups. To rule out the impact of home-country characteristics on our results, and recognizing the shortcomings of our sample data in this respect – including small sample size, the presence of outliers and evidence of non-normality in underlying distributions – we again perform non-parametric median-equality tests on only the 18 banks from these three countries. While these results should be interpreted with caution, given the small sample of banks involved, they are generally similar to those reported in Table 2. Specifically, while a comparison of means (and medians) between the two groups of banks in this smaller sample largely conform to our earlier hypotheses for all of the variables (as shown in Table 2), we observe slightly weaker statistical evidence with regard to the influence of the business model variable compared to Table 2, and notably stronger evidence in favour of the cost-efficiency variable.

Finally, we perform a further robustness check on our results in Table 2 using multivariate (logit) regression analysis as an alternative approach to examine the relationship between banks' pre-crisis condition and crisis performance. Use of regression analysis might provide improved understanding of our individual measures in terms of their (causal) relationship with crisis performance. We restrict our regression study to only those variables where data for the full sample of 78 banks are available. Further, to test sensitivity, we introduce alternative measures of both business and funding models, where both of these alternative measures are also statistically significant discriminants between the two groups of banks in a two-sample test of mean equality (as in Table 2).

Numerical results from the multivariate regression analysis are provided in Appendix B. As expected, these results align with our findings in Table 2. That is, the estimated coefficients on

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[22] We thank Yasuo Terajima of the Bank of Canada for suggesting this analysis as a sensitivity check.

the pre-crisis business model, funding model and balance-sheet liquidity variables all demonstrate the expected sign and are statistically significant determinants of the probability that a bank would require a bailout during the crisis.

3.2 Comparison of the major Canadian banks with their global peers

Next, we focus on the pre-crisis conditions and crisis performance of the major Canadian banks in the context of the results above.

3.2.1 Crisis performance

As has been widely publicized, the major Canadian banks performed relatively well during the 2007–09 financial crisis, collectively earning the title of the "soundest banking system in the world" in major international forums. No Canadian bank was declared bankrupt, was acquired or nationalized, or required a government recapitalization during this period, with the result that all six major Canadian banks qualify as "not bailed out" in our study. Table 3 shows how the Canadian banks compare, on average, to their global peers based on the three alternative crisis performance measures discussed earlier. Following Ratnovski and Huang (2009), we find it useful to compare the major Canadian banks and the four major Australian banks in Table 3, given the similar macroeconomic and banking structure characteristics in the two countries. The Australian banks were also characterized as "not bailed out" according to our crisis-performance indicator.

Table 3: Canadian banks' crisis performance relative to global peers

	Canadian banks	Australian banks	Other non-bailed-out banks	Bailed-out banks
Equity market-to-book ratio (End-2006)	2.66	2.68	2.47	2.07
Equity market-to-book ratio (End-2008)	1.77	1.83	0.99	0.71
Average annual pre-tax ROA (2007–09)	0.7	1.1	0.7	0.1
Average annual net charge-offs to loans outstanding (2007–09)	0.4	0.3	0.3	0.9

Notes: All values reported are in per cent, and reflect mean results for the identified group of banks. The "other non-bailed-out banks" group excludes Canadian and Australian banks.

Table 3 shows that Canadian and Australian banks stood out in terms of equity market performance during the crisis, exhibiting higher equity market-to-book ratios relative to their global peers before, and particularly during, the financial crisis. The results in Table 3 also show

that Canadian banks were comparatively profitable, but exhibited a slightly higher proportion of loan net charge-offs relative to other non-bailed-out banks in the sample. All metrics nonetheless give support to Canadian banks' strong crisis performance relative to the bailed-out banks in our sample.

3.2.2 Pre-crisis conditions

As for the pre-crisis condition of Canadian banks relative to their global peers, Table 4 shows how the Canadian banks compare, on average, to Australian and other global banks according to each of the measures in our study.

Consistent with the findings of Ratnovski and Huang (2009), Canadian banks are a positive outlier – even relative to their Australian peers – in terms of balance-sheet liquidity and, to a lesser extent, funding model. This likely reflects the large and stable retail deposit base to which they have access in Canada, which would serve to reduce both the denominator of our balance-sheet liquidity measure and the numerator of our funding measure.[23] Of particular note, we find that the major Australian banks all rank in the bottom quartile of banks in terms of balance-sheet liquidity (i.e., they rank among the banks with the lowest balance-sheet liquidity), while the major Canadian banks rank within the top quartile – despite both groups of banks not requiring a bailout according to our crisis performance metric. There could be a number of explanations for this, including in relation to how balance-sheet liquidity is being measured in our study. Business model results are also largely as expected, though Canadian banks do not necessarily stand out in this respect relative to other non-bailed-out banks.[24]

Among the other notable findings in Table 4, Canadian banks appear to have exhibited a more conservative risk appetite relative to their global peers entering the crisis, according to our first proxy measure. From a purely numerical standpoint, this could be tied to explicit Canadian government guarantees on qualifying residential mortgages which, in turn, carry a significantly lower risk weighting relative to uninsured mortgages. In addition, and as has been suggested by a number of commentators, Canadian banks entered the crisis with notably greater Tier 1 capital ratios.[25]

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[23] Again, to be clear, the denominator of our balance-sheet liquidity measure captures only short-term non-deposit sources of funding for banks in the sample. This means that wholesale and commercial deposits placed with these banks are not being captured in the denominator, despite typically being characterized as relatively volatile sources of funding.

[24] Though, excluding RBC and National Bank of Canada from the Canadian calculations, the value of the business model measure for the Canadian group would fall to roughly 10 per cent.

[25] This is not surprising, since Canadian banks were required, in accordance with OSFI's adoption of the Basel Capital Adequacy Requirements, to target a Tier 1 capital ratio of 7 per cent RWA, compared to the Basel Committee's suggested Tier 1 minimum of 4 per cent RWA.

Overall, these results generally support the view that risk-management practices at the major Canadian banks remained prudent during the lead-up to the global financial crisis, and likely helped them to weather the subsequent storm better than many of their global peers.

Table 4: Canadian banks' pre-crisis condition relative to global peers

	Canadian banks	Australian banks	Other non-bailed-out banks	Bailed-out banks
Business model	12.1	5.0	10.2	20.1
Funding model	18.2	20.5	21.3	35.1
Balance-sheet liquidity	236.8	59.5	141.7	98.2
Bank size (US$ million)	304,209	277,330	726,871	705,800
Capital adequacy ^	10.4	7.1	8.5	8.4
Leverage	21.4	17.5	21.7	24.3
Risk appetite ^	43.1	65.2	51.9	54.0
Risk appetite (alternative)	1.84	2.88	1.57	1.89
Cost-efficiency	63.6	57.4	54.6	56.7

Notes: All values reported are in per cent unless otherwise specified, and reflect mean results for the identified group of banks. The "other non-bailed-out banks" group excludes Canadian and Australian banks. ^ excludes the major U.S. investment houses.

An obvious question that follows is: *what were the underlying factors contributing to Canadian banks' relatively sound risk-management practices leading up to the crisis?*

As has been mentioned, and as will be elaborated on in the next section, developments since the 1980s in the policy framework that influences financial sector behaviour in Canada, as well as lessons learned by the Canadian banks themselves over the same period, were strong contributing factors to their prudent risk-management practices prior to, and performance during, the crisis of 2008–09.

At the same time, however, some researchers (e.g., Bordo, Redish and Rockoff 2011; Knight 2011) have suggested that Canadian banks' high franchise value also helped as a disciplinary device to limit incentives to take excessive risk in the run-up to the crisis. That is, Canadian banks, with their highly profitable domestic franchises, had much to lose if a risky business strategy were to backfire.[26]

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[26] Based on information in the major Canadian banks' annual reports, we estimate that the ROE on their domestic personal and commercial banking business averaged between 25 and 30 per cent in 2006.

Demsetz, Saidenberg and Strahan (1996) define franchise value as "the present value of the future profits that a bank is expected to earn as a going concern." They suggest that franchise value in banking arises from two main sources: (i) "market-related" sources, such as limits on competition in the sector, and (ii) "bank-related" sources, such as efficiency differences and the strength of client relationships. These researchers find strong empirical evidence of a negative relationship between franchise value and firm risk in a sample of more than 100 bank holding companies in the United States between 1986 and 1994. That is, they find that banks with higher franchise value maintain stronger capital positions, and take on less portfolio risk, all leading to lower firm risk. This suggests that the existence of high franchise value may align the incentives of bank management with those of the supervisor toward risk aversion and prudence.

While a study of the impact of franchise value on risk-taking in the Canadian banking sector is beyond the scope of this paper, this could be a fruitful topic for future research. At this time, however, we simply note that, based on one potential measure of franchise value cited by the above researchers – the ratio of market-to-book value of bank equity – the empirical evidence in this paper shows that Canadian (and Australian) banks exhibited higher franchise value prior to the crisis, compared to their peers in the United States, the United Kingdom and the euro area (e.g., Chart 2 and Table 3).

4. Canadian Regulatory and Communication Structures

The international evidence examined above identifies several aspects of Canadian banks as a group that appear to have contributed to a strong relative performance during the financial crisis of 2007–09. These include a less-risky business model, a more-robust funding model, and strong balance-sheet liquidity. In general, there is a strong focus on the quality of bank risk management.

A salient question is why this should be the case relative to other banking systems. In Canada, strong risk-management practices are often attributed to a traditionally conservative business culture. While this undoubtedly played a role, it is only part of the answer. It is instructive that Cecchetti, King and Yetman (2011) find that economies experiencing a banking crisis between 1990 and 2007 fared better during the economic and financial turmoil that followed. They suggest that this resulted from the impetus such crises gave to improving the robustness of the domestic financial system, often reflected in increased capitalization of the banks. Canada has never had a banking crisis, but as we discuss below, there were a variety of significant shocks to

the domestic banking system that spurred the authorities to foster an environment of prudent risk management (for which there may already have been a natural tendency).[27]

4.1 Some difficult historical episodes

Although both the Canadian banking sector and the housing sector performed well during the recent financial turmoil, this has not always been the case historically. Following the failure of the Home Bank in 1923, bank failures were unknown in Canada until the surprising collapse of two banks, the Canadian Commercial Bank and the Northland Bank of Canada, in September of 1985.[28] These two banks were small, with combined assets of less than 1 per cent of total assets in the banking system. However, their concentration in the Western Canadian provinces, and in the oil, gas, and real estate sectors, and especially the rarity of bank failures in Canada, contributed to make this a high-profile event which led to a national inquiry.[29]

As Engert (2005) notes, the failure of these two banks added impetus toward reforming the financial sector policy framework in Canada, with particular focus on creating a regime with clearer goals and improved incentives among regulatory agencies and private sector institutions. In particular, the Office of the Superintendent of Financial Institutions (OSFI) was established in 1987, which reorganized and consolidated various existing supervisory activities.[30] In addition, information exchange between the key authorities during the bank failures of the 1980s was viewed as having been less than ideal. As a result, the OSFI Act in 1987 also created the Financial Institutions Supervisory Committee (FISC), which is chaired by the Superintendent of Financial Institutions and includes the Governor of the Bank of Canada, the Deputy Minister of Finance and the President of the Canadian Deposit Insurance Corporation, to facilitate communication among the federal financial authorities.[31] These changes were aimed at improving both the "ability to act" and "will to act" of prudential agencies. Finally, these events also reinforced the need to make improvements to some elements of Canada's payments system, culminating in the establishment of the Large Value Transfer System (LVTS) in the late 1990s.

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[27] Knight (2011) similarly argues that the robustness of the Canadian banking system went beyond an innate 'conservatism.'

[28] Some banks that encountered serious difficulties in the intervening years merged with other, healthier banks.

[29] The so-called Estey Commission. See Government of Canada (1986).

[30] OSFI was established in July 1987, by the Office of the Superintendent of Financial Institutions Act (OSFI Act). This legislation created a single regulatory agency responsible for the regulation and supervision of all federally chartered, licensed or registered banks; insurance companies; trust and loan companies; co-operative credit associations; and fraternal benefit societies. OSFI was created through the merger of its two predecessor agencies – the Department of Insurance and the Office of the Inspector General of Banks.

[31] More recently, the Commissioner of the Financial Consumer Agency of Canada also became a member of the FISC.

Moreover, while Canada's housing sector performed robustly through the recent financial turmoil and economic downturn, experience has shown that an ongoing absence of problems in Canadian housing and real estate cannot be assumed. Significant housing sector downturns occurred in the early 1980s and again in the early 1990s. While both were associated with broader recessions, there had been sharp regional run-ups in housing prices that were unsustainable.

In the first episode, residential construction had been on a slowing trend since its peak in 1976. Housing starts began to recover in the early part of 1981, only to collapse in the latter half as the economy began to enter recession. In 1982 there was an actual decline in nominal housing prices (-4 per cent nationwide, but -18 per cent in Vancouver and -7 per cent in Toronto). In addition, housing starts fell to their lowest level in over 20 years. The second episode occurred in the context of a particularly buoyant residential construction sector in the latter half of the 1980s, originally concentrated in Ontario but gradually spreading to the rest of the country. In 1990–91, however, there was an abrupt weakening in the housing sector as the economy slowed and speculative pressures unwound. The effects on banks were compounded by a slump in commercial real estate, putting additional upward pressure on their loan-loss provisions, which spiked sharply (Chart 11).

In both episodes, the decline in housing investment was considerably sharper than the average of previous cycles, with large relative-price movements (Chart 12). Although the large banks weathered the losses coming out of both downturns, these events nevertheless promoted awareness of the damaging effects that could arise from volatile residential housing and commercial real estate sectors.

Chart 11: Loan-loss provisions

Chart 12: Cyclical movements in house prices
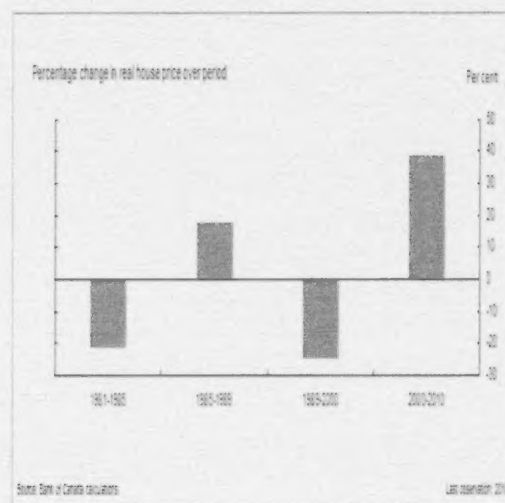
These earlier episodes were instructive, and contributed to the banking and regulatory environment that exists today. Put differently, Canadian banks' strong performance during the 2007–09 financial crisis is seen as having benefited from the lessons learned from past periods of financial system stress in Canada, and the subsequent changes put in place (in terms of regulation, supervision and banks' own risk-management practices) following these events.

4.2 Risk management and regulatory structures

A focus on risk management is a key element of OSFI's approach to prudential oversight. OSFI employs a principles-based supervisory approach that is intended to be broad-based and adaptive in nature, and therefore less open to arbitrage. Substantial discretion is retained to enunciate principles in guidance without requiring new legislation or regulations to be introduced. If institutions do not comply with the guidance, OSFI has the necessary practical and legal powers to enforce compliance.[32] Over time, OSFI has increased the emphasis it gives to evaluating a financial institution's material risks and the quality of its risk-management practices, as part of a comprehensive supervisory framework.[33]

As mentioned in the previous section, in the lead-up to the crisis, Canadian banks maintained substantial amounts of capital as a result of their own business practices and the regulatory regime. While Basel II standards required Tier 1 and total capital ratios of 4 per cent and 8 per cent, respectively, OSFI required the banks to target 7 per cent and 10 per cent, and in practice they typically held more, with a large proportion in the form of common equity. From a strong starting position at the beginning of the turmoil, the banks' capital positions were further buttressed by the strength of their retained earnings and the issuance of common shares during the crisis.[34]

Another key feature of the Canadian regulatory landscape was the implementation in the early 1980s of limits on bank leverage, known as the assets-to-capital multiple (ACM). The ACM is calculated as the ratio of total assets (including some but not all off-balance-sheet items) to total capital, and banks were not allowed to exceed specific limits (typically 20 or 23 for the large well-managed banks).[35] It is intended to capture elements that may not be adequately

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[32] For more detail on OSFI's regulatory approach, see Northcott, Paulin and White (2009, 46–50).

[33] For example, see OSFI (2010).

[34] Although direct capital support was not required, OSFI nevertheless increased the allowable limits on innovative and preferred shares in banks' Tier 1 capital.

[35] In these and other respects, the methodology underlying calculation of the ACM established by OSFI is quite different from the simpler leverage indicator used in our empirical work. The latter leverage measure was chosen for the empirical work given data availability for our entire sample of banks. The Basel Committee on Banking Supervision is currently finalizing a leverage ratio requirement, with implementation planned in the first fiscal quarter of 2018. Pending review of the final leverage requirements, OSFI expects that institutions will continue to meet an ACM test and to operate at or below their authorized multiple on a continuous basis. For more information on the construction of the ACM, see OSFI (2013).

reflected in the risk-weighted Basel framework and thereby complement that approach. There is some evidence that the ACM has restrained the behaviour of Canadian banks under certain conditions and in turn may have prevented them from growing their assets as aggressively as they might otherwise have done.[36] Leverage ratio requirements are not unique to Canada (e.g., they are also present in the United States), suggesting that the manner in which they are implemented is critical, especially with respect to asset coverage.

The above features of the regulatory and supervisory framework in Canada are viewed, at least in part, to have contributed to the large Canadian banks entering the recent period of financial stress with more robust risk-management practices, underpinned by a strong culture of collaboration among the pertinent public sector agencies. These practices helped to limit their exposure to some potentially riskier sectors and products. For example, subprime mortgages, as they occurred in the U.S. market, remained a relatively limited phenomenon in Canada.[37] Additionally, as described in section 2, the structure of mortgage finance in Canada, with the bulk of insured mortgages fully backed by the federal government, influenced banks' risk exposures.

Although OSFI is responsible for the prudential oversight of the most important financial institutions in Canada, it does not hold sole responsibility for the stability of the Canadian financial system. Implementing a system-wide approach to financial stability is a shared responsibility, and includes, in addition to OSFI, the Department of Finance, the Bank of Canada, the Canada Deposit Insurance Corporation and the Financial Consumer Agency of Canada. Having clear mandates and rapid communication among these agencies is important at all times, and proved invaluable in the midst of the recent crisis. As described earlier, in response to past difficulties in the Canadian financial system, a committee structure (FISC) already existed at the start of the crisis to encourage communication and coordination across these bodies. The FISC was used extensively during the financial turmoil as a venue to facilitate an overall policy response.

The structure of the Canadian banking system (discussed in section 2.2) is also viewed as having helped to facilitate robustness of the system as a whole. In particular, it fostered close communication between regulators and the banking community.

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[36] See Bordeleau, Crawford and Graham (2009) for further discussion of the impact of an unweighted leverage ratio in Canada.

[37] As mentioned earlier, banks' caution regarding high-risk housing exposures was reinforced by their own adverse experience during past episodes of financial stress in Canada. High-risk "subprime" mortgages before the crisis approached only 5 per cent of mortgage originations in Canada (much of this originated by smaller financial institutions), compared to over 20 per cent in the United States (see the Bank of Canada's June 2007 *Financial System Review*, pp. 6–9). For the state of Canadian banks' risk management at the beginning of the crisis, see Aaron, Armstrong and Zelmer (2007).

As mentioned, despite low credit losses throughout the period of global financial turmoil and domestic recession, Canadian banks faced sharply higher funding costs (although less severe than in many other banking systems). Clearly, cross-border contagion effects can have a powerful impact, even if the domestic financial system is performing well. This implies that financial institutions must be ready with adequate levels of privately sourced liquidity, and that the authorities must be prepared with the necessary facilities to provide liquidity support when warranted.

The Bank of Canada, alongside many central banks globally, intervened repeatedly to provide liquidity to financial market participants. The seriousness of the situation led to the expansion of the liquidity programs along a variety of dimensions, including the terms to maturity, amounts, counterparties and eligible securities. In addition, the federal government introduced a variety of initiatives to address gaps in credit markets. Aside from the previously mentioned IMPP, facilities such as the Canadian Lenders Assurance Facility and the Canadian Secured Credit Facility were introduced in 2008 and 2009, respectively.[38]

Going forward, the strains experienced in the Canadian financial system imply that having a robust banking system is insufficient in itself to avoid liquidity problems under all circumstances. New global liquidity standards that are under development will be important for the domestic banking system. The authorities are also drawing lessons from their recent experience and adjusting liquidity facilities and approaches to be better prepared for future market disruptions.

5. Conclusion – Implications for Bank Regulation and Standards

Canadian banks were able to weather the financial turmoil over the 2007–09 period, and indeed the renewed period of turmoil beginning in 2011, relatively well. A number of factors played a role in this outcome, but we emphasize here the positive contribution from a strong risk-management environment. This emphasis is supported by our quantitative results, which indicate that global banks that had a less-aggressive business model, a more-robust funding model, and stronger balance-sheet liquidity, among other elements, required less official support during the crisis. Based on the internationally comparable metrics we examine, the Canadian banks (as well as their Australian peers) compare favourably. This suggests several important areas of emphasis going forward (for authorities both inside and outside Canada). We acknowledge that, in practice, the identified policies must include an assessment of their costs as well as their benefits, with a view to supporting financial system efficiency in conjunction with stability.

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[38] See Zorn, Wilkins and Engert (2009) for a detailed description of central bank liquidity actions during the turmoil, as well as a summary of federal government programs.

First, banks need to place a strong emphasis on their risk-management function, where the appropriateness of a bank's risk-management practices should not be assessed based on a bank's level of capital alone.[39] In view of the Canadian experience and the quantitative evidence provided here, banks and supervisors should engage in strong monitoring of institutions' exposures to trading activities and other fat-tailed revenue-generating businesses, the housing sector, and the shadow banking sector, among other business activities. Second, the regulatory function needs to motivate and support a robust risk-management environment. This was a key area for Canadian supervisory authorities. They introduced various measures, such as higher capital requirements and explicit leverage ratios that were helpful in their own right. More importantly, they reflected an underlying supervisory attitude that focused on strong risk management, and the authorities' expectations that financial institutions would themselves make this a priority.

The emphasis on risk management among Canadian authorities and banks, in turn, arose for a variety of reasons. A key contributing factor was financial system stress that has occurred in the past, including the failure of some small Canadian banks and upheaval in the domestic housing and commercial real estate markets. These episodes demonstrate that the Canadian financial system is not immune to problems, and they contributed to an improved framework governing behaviour in Canada's financial system, including adoption of better risk-management practices at banks. Another positive outcome was the establishment of clear mandates, incentives and communication structures for all of the domestic government agencies that contribute to financial stability.

Aside from the banks' business models, our empirical results emphasize the contribution that sound funding models and balance-sheet liquidity can give to weathering financial storms. Although Canadian banks compared well in both categories, in retrospect they still remained vulnerable to funding market contagion. A rather harsh lesson was that cross-border contagion may subject even banking systems that are performing relatively strongly to significant funding and liquidity pressures. While such pressures can be considerably worse for banking systems that are already experiencing problems of their own, this suggests the need for robust liquidity management across jurisdictions broadly, and thus our results appear to support ongoing efforts to introduce liquidity-enhancing elements to the international regulatory and supervisory regimes. Banks need to have in place strengthened liquidity frameworks, emphasizing private sector sources of liquidity, at least for the initial stages of any period of turmoil. For their part, the authorities need to review their liquidity policies, drawing on the lessons of recent years so that they are better prepared for future crises.

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[39] Along this same line, Dickson (2010) stresses that effective supervisory oversight should be viewed as equally important to rule-making when building authorities' prudential tool kit.

A further contributing factor to strong risk management cited in some studies is the franchise value of banks. According to some metrics, Canadian (and Australian) banks exhibited relatively high franchise value prior to the onset of the crisis. Certainly, some structural features of the Canadian banking system could be viewed as supportive of robust franchise value. This is an area that could be pursued in future research, particularly the link between franchise value and the generation of incentives that constrain risk-taking behaviour.

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Appendix A: List of Banks in Global Sample

Full name	Home country	Bailout
Barclays PLC	United Kingdom	0
HSBC Holdings PLC	United Kingdom	0
Mitsubishi UFJ Financial Group	Japan	0
Mizuho Financial Group	Japan	0
Deutsche Bank AG	Germany	0
Banco Santander SA	Spain	0
UniCredit SpA	Italy	0
Credit Suisse Group AG	Switzerland	0
Industrial and Commercial Bank of China (The)	China	0
Sumitomo Mitsui Financial Group, Inc.	Japan	0
Intesa Sanpaolo	Italy	0
China Construction Bank Corporation	China	0
Bank of China Limited	China	0
Banco Bilbao Vizcaya Argentaria SA	Spain	0
Danske Bank A/S	Denmark	0
Royal Bank of Canada	Canada	0
Nordea Bank AB	Sweden	0
National Australia Bank Limited	Australia	0
Toronto-Dominion Bank	Canada	0
Bank of Nova Scotia (The)	Canada	0
Bank of Montreal	Canada	0
Skandinaviska Enskilda Banken AB	Sweden	0
Canadian Imperial Bank of Commerce	Canada	0
Standard Chartered PLC	United Kingdom	0
Bank of Communications Co. Ltd	China	0
Commonwealth Bank of Australia	Australia	0
Westpac Banking Corporation	Australia	0
Australia and New Zealand Banking Group	Australia	0
United Overseas Bank Limited	Singapore	0
Svenska Handelsbanken	Sweden	0
DnB ASA	Norway	0
Deutsche Postbank AG	Germany	0
National Bank of Canada	Canada	0
Banco Popular Espanol SA	Spain	0
Kookmin Bank	South Korea	0
Swedbank AB	Sweden	0
Banca Monte dei Paschi di Siena SpA	Italy	0
Rabobank Nederland-Rabobank Group	Netherlands	0
DZ Bank AG-Deutsche Zentral-Genossenschaftsbank	Germany	0

UBS AG	Switzerland	1
BNP Paribas	France	1
Citigroup Inc	United States	1
Royal Bank of Scotland Group (The)	United Kingdom	1
Credit Agricole S.A.	France	1
Bank of America Corporation	United States	1
JP Morgan Chase & Co.	United States	1
Societe Generale	France	1
HBOS PLC	United Kingdom	1
Commerzbank AG	Germany	1
Dexia	Belgium	1
Wachovia Corporation	United States	1
Lloyds Banking Group PLC	United Kingdom	1
Wells Fargo & Company	United States	1
KBC Groep NV	Belgium	1
WMI Holdings Corp	United States	1
Fifth Third Bancorp	United States	1
US Bancorp	United States	1
Hypo Real Estate Holding AG	Germany	1
Allied Irish Banks PLC	Ireland	1
Bank of Ireland-Governor and Company of the Bank of Ireland	Ireland	1
PNC Financial Services Group Inc	United States	1
Erste Group Bank AG	Austria	1
National City Corporation	United States	1
SunTrust Banks, Inc.	United States	1
BB&T Corporation	United States	1
Natixis	France	1
Groupe Caisse d'Epargne	France	1
Landesbank Baden-Wuerttemberg	Germany	1
Bayerische Landesbank	Germany	1
Portigon AG (formerly WestLB)	Germany	1
Banque Federative du Credit Mutuel	France	1
Northern Rock (Asset Management) PLC	United Kingdom	1
Goldman Sachs Group, Inc	United States	1
Lehman Brothers Holdings Inc.	United States	1
Morgan Stanley	United States	1
Merrill Lynch & Co., Inc.	United States	1
HSH Nordbank AG	Germany	1
Bear Stearns Companies LLC	United States	1

Appendix B: Regression Analysis of Bank Indicators

As mentioned in section 3, as a check on the robustness of our empirical findings, and to get a sense of the interaction of these individual indicators in terms of their overall (causal) relationship with crisis performance, we also perform multivariate (logit) regression analysis using the same data. Results of the regression analysis are provided in Table B1.

Two alternative regression specifications are shown in Table B1, to reflect inclusion of both our primary and alternative measures of pre-crisis business model and funding model. Our alternative business model measure draws on balance-sheet data, and is based on the proportion of on-balance-sheet assets made up of tradable securities. We use the ratio of marketable securities held on balance sheet to total earning assets. The numerator is constructed by Bloomberg, and includes securities held for trading and available for sale – including MBS and related securities. As Beltratti and Stulz (2009) point out, banks with a larger proportion of their assets in the form of tradable securities will presumably have more assets required to be marked-to-market. As a potential drawback in this respect, the numerator does not distinguish between government-issued and privately issued securities, nor does it offer even high-level detail regarding the pricing models and related inputs used to generate the carrying values of these securities. Nonetheless, in our view this seems a reasonable proxy to capture, at a high level, the proportion of a bank's involvement in capital markets activity relative to that of, say, more traditional lending to non-financial firms and households. Our alternative funding model measure is constructed as the ratio of total customer deposits as a proportion of total funding.

As mentioned in the text, the multivariate regression analysis is restricted to only those variables reported by all 78 banks in the sample – measures of risk appetite and capital adequacy and quality are therefore excluded.

As shown in Table B1, the results from our regression analysis align closely with those reported earlier in Table 2. That is, the estimated coefficients on the pre-crisis business model, funding model, and balance-sheet liquidity variables all demonstrate the expected sign and are statistically significant determinants of the probability that a bank would require a bailout during the crisis.

Table B1: Multivariate regression results

Logistic regression results Dependent variable = 1 if bailed out; 0 otherwise. Robust standard errors in parentheses. Maximum likelihood estimation.		
	Specification 1	Specification 2
Constant	5.117467 (4.667)	8.974582 (5.100)
Business model 1	0.0666747 ** (0.032)	
Business model 2		0.0774138 *** (0.028)
Funding model 1	0.059361 ** (0.030)	
Funding model 2		-0.0435382 ** (0.020)
Balance-sheet leverage	-.0212421 (0.035)	-0.0351104 (0.040)
Cost-efficiency	0.0053211 (0.026)	-0.0114656 (0.028)
Balance-sheet liquidity	-0.01147 ** (0.005)	-0.0143377 ** (0.007)
Log size	-0.4625835 (0.392)	-0.4361273 (0.389)
Observations	78	78
Log pseudo-likelihood	-40.04	-37.44
Pseudo R-squared	0.2594	0.3074
Wald Chi-square (8)	22.47	17.93

Note: *** Significant at 1% level, ** significant at 5% level, * significant at 10% level.